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AN INSTRUMENT TO MEASURE SYNTACTIC MATURITY, PRELIMINARY VERSION.

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THE PURPOSES OF THIS EXPERIMENT CONDUCTED IN THE TALLAHASSEE, FLORIDA PUBLIC SCHOOLS WERE (1) TO STUDY DIFFERENCES IN SENTENCE STRUCTURES AMONG STUDENTS VARYING IN CHRONOLOGICAL MATURITY AND MENTAL ABILITY WITHIN GRADES 4, 6, 8, 10, AND 12, AND (2) TO SEE IF AN INSTRUMENT COULD BE DEVISED TO EFFICIENTLY MEASURE SYNTACTIC MATURITY. THE INSTRUMENT CONSISTED OF A PASSAGE OF 32 SIMPLE SENTENCES WHICH THE 1,000 STUDENTS, AS WELL AS 25 ADULTS SKILLED IN WRITING, WERE ASKED TO REWRITE "IN A BETTER WAY." THE DEGREE OF SYNTACTIC MATURITY WAS COMPUTED BY COUNTING THE NUMBER OF CLAUSES, OR T-UNITS, AND THE NUMBER OF WORDS IN THE FINISHED COMPOSITIONS AND DIVIDING THE LATER BY THE FORMER TO GET T-UNIT LENGTH. THE RESULTS INDICATED THAT MORE MATURE AND ABLE STUDENTS TEND TO REDUCE CLAUSES TO WORDS OR PHRASES AND TO INCORPORATE THESE INTO LONGER T-UNITS. MOREOVER, THE WRITING OF SKILLED ADULTS SEEMED TO EXTEND THE TRENDS OF SYNTACTIC MATURITY OF SCHOOLCHILDREN. ALTHOUGH THE INSTRUMENT APPEARED RELIABLE FOR MEASURING GROUP ACHIEVEMENT, ITS RELIABILITY FOR MEASURING THE SYNTACTIC PERFORMANCE OF THE FREE WRITING OF AN INDIVIDUAL NECESSITATES FURTHER RESEARCH. (JS)

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(Preliminary Version)

AN INSTRUMENT TO MEASURE SYNTACTIC MATURITY

Kellogg W. Hunt and others

Florida State University
Tallahassee, Florida
1968

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AN INSTRUMENT TO MEASURE SYNTACTIC MATURITY

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Chapter I

The purpose of the experiment

The general purpose of this experiment is to study the differences in the sentence structures (the syntactic structures) written by schoolchildren at various stages of chronological maturity, and at various levels of mental ability or achievement within the same grade. The writing of skilled adults is also studied.[1]

More specifically, this study is designed to answer certain questions which have grown out of other enquiries published since 1963. The most important of such questions are these:

1. If students at various grade levels were all saying the same thing in writing, would the older students tend to say it in longer clauses -- in clauses that require more sentence-combining transformations to generate?

2. Do those same syntactic characteristics that develop from grade to grade as students get older also serve to distinguish between students of greater than average and less than average ability or

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[1]This study was supported in part by Florida State University, Department of English, and in part by the U.S. Office of Education under an Educational Research Training Program grant. The graduate trainees who performed the research were Max Morenberg, Mike Pope, James Richardson, Andrew Rogers, Jr., William L. Smith, and Louise Todd Taylor.

achievement within each grade? To state it more simply, in the same grade, are above-average children ahead of below-average children in their syntactic maturity, or is syntactic maturity, as measured here, related to chronological maturity alone?

3. What other syntactic characteristics besides the increase in clause length -- in the number of sentence-combining transformations required to generate the average clause -- can also be discerned in the writing of more mature and more able students?

4. Can an instrument be devised to measure syntactic maturity in a way that is less expensive than the analysis of large samples of students' original writing?

Related Studies

The previous studies most closely related to this one are by Hunt and by O'Donnell, Griffin, and Norris. These previous studies used the same kind of analysis that will be used here. Hunt's first study concerned the writing of children of average IQ (90-100) in grades 4, 8, and 12.[1] Later he studied the writing of "skilled adults", those whose non-fiction is published in Harpers and Atlantic.[2] Also he studied the writing of children of superior

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[1]Kellogg W. Hunt, Differences in Grammatical Structures Written at Three Grade Levels. (Cooperative Research Project No. 1998, 1964)

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[2]Kellogg W. Hunt, Grammatical Structures Written at Three Grade Levels. Research Report #3. (Champaign: National Council of Teachers of English) 1965.

IQ (above 130) in grades 4 and 12.[1] O'Donnell, Griffin, and Norris[2] studied

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[1]Kellogg W. Hunt, Sentence Structures Used By Superior Students in Grades Four and Twelve and by Superior Adults. Cooperative Research Project No. 5-0313, 1966.

[2]Roy C. O'Donnell, William J. Griffin, Raymond C. Norris, Syntax of Kindergarten and Elementary School Children: A Transformational Analysis. Research Report #8. (Champaign: National Council of Teachers of English) 1967.

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the speech of children in kindergarten, grades 1, 2, 3, 5, and 7, and also studied the writing of the same children in grades 3, 5, and 7.

Degrees of control of subject matter

The major difference between those studies and this one is in the degree of control exercised by the investigators over the students' subject matter or content: that is, what the students wrote about, what they said. In his previous studies Hunt exercised a minimum of control. He studied whatever writings happened to be produced by certain students at the time he was collecting samples. Similarly, his writings from Harpers and Atlantic were on whatever expository subject happened to appear in the issues published at the time he was making his study.

In contrast to this minimal control of content, O'Donnell, Griffin, and Norris used moderate control. They did control the stimulus for their students' speech and writing. Two short movies with their sound tracks turned off were shown to the students, and the students were then asked to comment on the movies.

The motivation for this study

Though the relevant findings of the studies just cited will be reviewed in much greater detail in later sections of this report, those findings are

referred to here simply to explain the motivation for the present study. To a certain extent the present study is designed to confirm the earlier findings under more rigorously controlled conditions. But the present study is designed also as a critical experiment to ascertain certain things that the earlier study could not, in principle, determine.

The studies just cited produced strong evidence that as children mature they tend to produce on the average, more words per T-unit.[1] For speech the

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[1]A T-unit is a main clause plus any subordinate clause or non-clausal structure that is attached to or embedded within it. How to segment a passage into T-units is illustrated in the following fourth grader's one sentence theme where every double slash indicates the end of one T-unit and the beginning of the next.

> I like the movie we saw about Moby Dick the white whale//the captain said if you can kill the white whale Moby Dick I will give this gold to the one that can do it//and it is worth sixteen dollars//they tried and tried//but while they were trying they killed a whale and used the oil for the lamps//they almost caught the white whale.

It is grammatically allowable to punctuate any T-unit as a sentence. And T-units are the shortest segments that it is allowable to punctuate in this way without creating fragments in between. The term "T-unit" is short for "minimal terminable unit."

How to compute the five figures which are later mentioned as the Synopsis of Clause to Sentence Length Factors is as follows. The above passage contains 68 words, 11 clauses, 6 T-units, and 1 sentence. The mean number of words per clause (clause length) is 68/11 or 6.2; the mean number of clauses per T-unit (or per main clause) (the subordinate clause index) is 11/6 or 1.8; the mean number of words per T-unit (T-unit length) is 68/6 or 11.3; the mean number of T-units per sentence is 6/1 or 6; the mean number of words per sentence is 68/1 or 68.

O'Donnell study found such an increase to occur between every pair of intervals studied: K, G1, G2, G3, G5, G7. That study also found an increase for writing between G3 and G5 and between G5 and G7. It thus supported Hunt's earlier

finding of an increase for writing from G4 to G8 to G12. Hunt also found a very substantial increase for the writing of skilled adults.

It is obvious that one T-unit can be longer than another for either or both of two reasons: it has more words per clause, or it has more subordinate clauses per main clause (per T-unit). Hunt found that both factors contributed to the increase during the school years, from G4 to G12: that is, older students wrote both more words per clause and also wrote more subordinate clauses per main clause.

He then checked to see whether such differences were related to mental maturity as differentiated from chronological maturity. He compared the writings of children of superior IQ (above 130) and of average IQ (90 to 110) in grade 4 and also in grade 12. He found that as late as the twelfth grade the superior students wrote substantially longer clauses than average students in the same grade. And he found that skilled adults (those who publish articles in Harpers and Atlantic) wrote still longer clauses. But as early as the fourth grade superior students wrote clauses no longer than those written by average students.

But for all these studies the question remained unanswered whether the observed syntactic differences were due to differences in what was said. More mature students do indeed have more to say. Could it be that this more which they have to say, is in some undefined sense, elaborative, peripheral and subordinate, thus requiring longer clauses and longer T-units? If younger children also had this to say would they too say it in T-units and clauses as long as those of older children?

To answer that question is one of the chief motivations for this experiment. By excluding as nearly as possible the subject matter variable, it should be possible to come closer to isolating the differences in syntactic performance.

Furthermore, an instrument which excludes that variable should be a more sensitive and efficient device for measuring syntactic maturity.

Rigorous control of what is said

In line with this motivation, the present study, in contrast with the earlier studies mentioned, exercises maximal control over the content, the subject matter of what the students say. If what all writers say is kept as nearly as possible the same, then differences in how they say it should be more easily discerned. Of course what they are to say must be given to them in some medium of communication, but the experimenter's job is to minimize as best he can the effect of that medium.

In 1965-66 Dr. Roy O'Donnell undertook a pioneering experiment of the sort to be described here. He had students re-write a passage which he had written in extremely simple sentences. His first instrument, a narrative entitled "The Old Man and the Hen," succeeded in eliciting longer T-units from students in the middle grades than in the lower, but failed to elicit still longer T-units from high school students. Even so, that instrument is used for a minor role in this study.

Six graduate students in the Florida State University research trainee program then tried out a dozen different new passages with various sets of instructions, and, in small pilot studies, succeeded in eliciting successively

longer clauses and successively longer T-units from students in lower elementary and high school grades. With this experience as background, Dr. O'Donnell was asked to write a new instrument on an expository subject, and it is this that the present study relies on primarily.

That instrument consists of 32 sentences of connected discourse. The sentences are shorter than those normally spoken or written by even kindergarten children: they average about 4 1/3 words. Each is a single clause.

The extremely short sentences give abundant opportunities for the student to use many of the sentence combining transformations that, according to the previous studies mentioned, older students do use with increasing frequency.

The instructions enjoin the student to re-write the passage "in a better way." No further suggestions would have been given as to what the "better way" might be had it not been for the discovery during the pilot studies that, when students were allowed to feel perfectly free to make changes, they added and subtracted so much material that various students could not be said any longer to be "saying the same thing." So the directions to the student had to specify what he was allowed to change and what he was not.

The actual directions and the passage were as follows.

ALUMINUM

DIRECTIONS: Read the passage all the way through. You will notice that the sentences are short and choppy. Study the passage, and then re-write it in a better way. You may combine sentences, change the order of words, and omit words that are repeated too many times. But try not to leave out any of the information.

Aluminum is a metal. It is abundant. It has many uses. It comes from bauxite.

Bauxite is an ore. Bauxite looks like clay. Bauxite contains aluminum. It

contains several other substances. Workmen extract these other substances from the bauxite. They grind the bauxite. They put it in tanks. Pressure is in the tanks. The other substances form a mass. They remove the mass. They use filters. A liquid remains. They put it through several other processes. It finally yields a chemical. The chemical is powdery. It is white. The chemical is alumina. It is a mixture. It contains aluminum. It contains oxygen. Workmen separate the aluminum from the oxygen. They use electricity. They finally produce a metal. The metal is light. It has a luster. The luster is bright. The luster is silvery. This metal comes in many forms.

Selecting writers to get a "normal" distribution of ability

This instrument, together with another which will not be discussed here, was administered to more than a thousand students in grades 4, 6, 8, 10, 12 in the public schools of Tallahassee, Florida. The students were almost exclusively white. Steps were then taken to select from each grade 50 students who would represent something close to a normal distribution of academic ability. A normal curve for 50 students was divided into intervals one half a standard deviation wide, and the number of students that would be needed to fill each of those intervals was then calculated. (However, to avoid the necessity for finding students with extremely high and low scores, the three intervals at the extreme ends of the bell curve were merged so as to represent one and a half standard deviations rather than one half.) Then on the basis of their scores on certain standardized tests the number of students needed to fill each interval were chosen at random.

The standardized tests which had already been administered to these students were, for grades 4 and 6, the California Achievement Test; for grades 8 and 10, the California Test of Mental Maturity; for grade 12, The Florida Twelfth Grade Test. It was on the basis of scores on these tests that the distribution was made.

Dividing each grade into "high", "middle" and "low" thirds

These 50 students from each grade were further sub-divided into three groups of approximately equal size according to their scores on these standardized tests: 17 formed the "high" third, 16 the "middle" third, 17 the "low" third. The actual mean scores of the 17 students in the high ability group for each grade were, in percentiles, from 82.6 to 83.6; in IQ scores, from 116.9 to 117.5. For the 16 students in the middle third for each grade, actual mean scores were, in percentiles, 48.1 to 50.2; in IQ scores, from 100 to 101.3. For the 17 students in each low group the actual mean scores were, in percentiles, from 16.8 to 18.4; in IQ scores, from 79.4 to 84.4. In other words, the actual mean scores of the three groups for each grade did not differ significantly from what they would have been in a perfectly normal distribution.

The exclusion of foreign matter

After the students' papers were typed, they were then screened for extraneous, unintelligible, or inaccurate passages. Where such passages occurred, the whole sentence containing that expression was discarded. Passages such as the following were judged to contain inaccurate or unintelligent material:

The luster is silvery that comes in many forms.

They take the mass substances out by using filters then they put it in several other substances because a liquid remained.

They grind it and put it in remove mass with use filter.

Passages such as the following were judged extraneous:

This is a non-fiction story about aluminum.

This metal, like I said before has many uses and comes in varied forms.

The first stage of syntactic analysis

The syntactic analysis then proceeded in two stages. The second stage will be discussed in a later chapter. The first stage consisted of counting the number of words, the number of clauses, the number of T-units, and the number of sentences in each piece of writing. The criterion used to decide whether a certain expression was to be counted as a clause was the same as that which appears in most schoolbook grammars: the expression must contain a subject (or coordinate subjects) and must contain a finite verb (or coordinate verbs). Whatever a student wrote between an initial capital letter and a period or other terminal mark was counted as a sentence. The criterion for a T-unit was that it consist of one main clause plus whatever subordinate clauses and non-clausal expressions are attached to or embedded within it.

The numbers of words, clauses, T-units and sentences for each piece of writing were then used in figuring the five ratios that in previous research have been called the Synopsis of Clause-to-Sentence Length factors. Those five Synopsis measures are: (1) mean words per clause (clause length), (2) mean clauses per T-unit (subordinate clause index), (3) mean words per

T-unit (T-unit length), (4) mean T-units per sentence (main clause coordination index), (5) mean words per sentence (sentence length).

Taking those scores for each student's writing, means were then computed for each grade as a whole and also for the high, middle, and low ability groups within each grade. Appropriate statistical tests for significance were then made. An analysis of variance was made to see whether the differences from one grade to another were significant, whether the differences from one ability group to another within each grade were significant,[1] and whether the interaction of grade and ability group was also significant. If the analysis of variance showed a syntactic measure to be significantly different for ability groups across all grades taken as a whole, then the Newman Keuls test was made to see between which grades the differences were significant. Pearson product moment correlations were also determined between the ability or achievement scores and the various syntactic measures at each grade level. The results of these various statistical tests will be reported as each of the five syntactic measures is now discussed.

[1] In reporting the statistical results, the label SS for Standard Score, is used to designate the students' scores on the standardized ability or achievement tests already named.

Relating this writing to free writing

It is obvious at the outset, of course, that a set of short sentences chosen at random might or might not be re-written by schoolchildren in such a way as to reflect the same growth in syntactic maturity that those same children display in their own free writing. But of course the sentences used here

were not chosen at random. Instead they were carefully contrived so as to give the student every opportunity to exhibit at least some of the same characteristics that the previous studies had found they exhibited in their free writing. The passage used here is a test passage, not a piece of random prose.

But that does not mean either that the cards were stacked to give pre-determined differences from group to group. The youngest student was given full opportunity to write like the oldest. The least able was given full opportunity to write like the most able. The input was the same to all students. So the difference between the experimenter's input and the student's output was determined by the student alone. The differences between the output of one group and the output of another were put there by the groups themselves.

To repeat, the one obvious difference between the re-writing called for here and the original writing normally required of schoolchildren is that here the subject matter which served as input was constant from writer to writer. Differences in syntax from writer to writer reflect the writer's differences uncontaminated by differences in their subject matter.

What would be a perfect measure of maturity?

A graph representing the mean chronological age of the children studied in each grade would go up in virtually a straight line. Obviously any perfect measure for a characteristic which was, in turn, perfectly related to chronological age would also go up in virtually a straight line. Some of the

syntactic measures to be presented in the following paragraphs will show such a close relationship, whereas others will rise sharply across one grade interval and then level off or indeed fall across another later interval. The closer the line is to straight, the more closely that measure reflects chronological maturity.

A graph of the mental maturity of all students in a grade would also, of course, go up similarly since at each grade level the distribution is normal. But within each grade the mental maturity of the low group is about two years behind that of the grade as a whole. That is, in mental age, the mean for sixth graders in the low third of their class is close to the mean for middle group fourth graders, students two years younger. It is lower than the mean for high group fourth graders. Conversely, in mental age, the mean for the high group is close to the mean for the middle group two years older. So a syntactic measure that is closely related to mental maturity will go up in nearly a straight line, taking each grade as a whole, but the mean scores for the low third should be close to those for the middle group two years younger. For the high group the difference will be the same amount but in the opposite direction: high sixth graders should be close to average eighth graders. These are the considerations to bear in mind as the scores for the five syntactic measures are reported.

Sentence length

Until fairly recently sentence length has been the most widely used objective measure of language maturity. But the inadequacy of the index has

by now been noticed often.

In the writings for this study there is some rough correspondence between sentence length and maturity. At least it is true that the three older grades write longer sentences than the two younger grades, as Figure 1 and Table 1 indicate. But little more can be said for this index. It fails at several points. For instance, of the two younger grades the older one writes sentences that are shorter rather than longer. And among the three older grades tenth graders write shorter sentences than the younger eighth graders.

To point out further inadequacies, at the two younger grades the two high ability groups write shorter sentences than their less able classmates. Actually this phenomenon is the result of deeper regularities which will be shown in the next two sections.

The analysis of variance indicates significance for grade, but not for ability and achievement, or the interaction of grade and ability.

In brief then, older students do write longer sentences, but the relation to either chronological or mental maturity is very rough. The findings of this study confirm the findings from studies of free writing.

Main clause coordination index

Of the several ways to write longer sentences, one immature way is to string together a great number of main clauses with and's or nothing between. Hunt found that in free writing the average fourth grader coordinated main clauses, usually with and or nothing between, almost twice as often per thousand words as the older eighth graders did, and three or four times as often as

Figure 1: Sentence Length

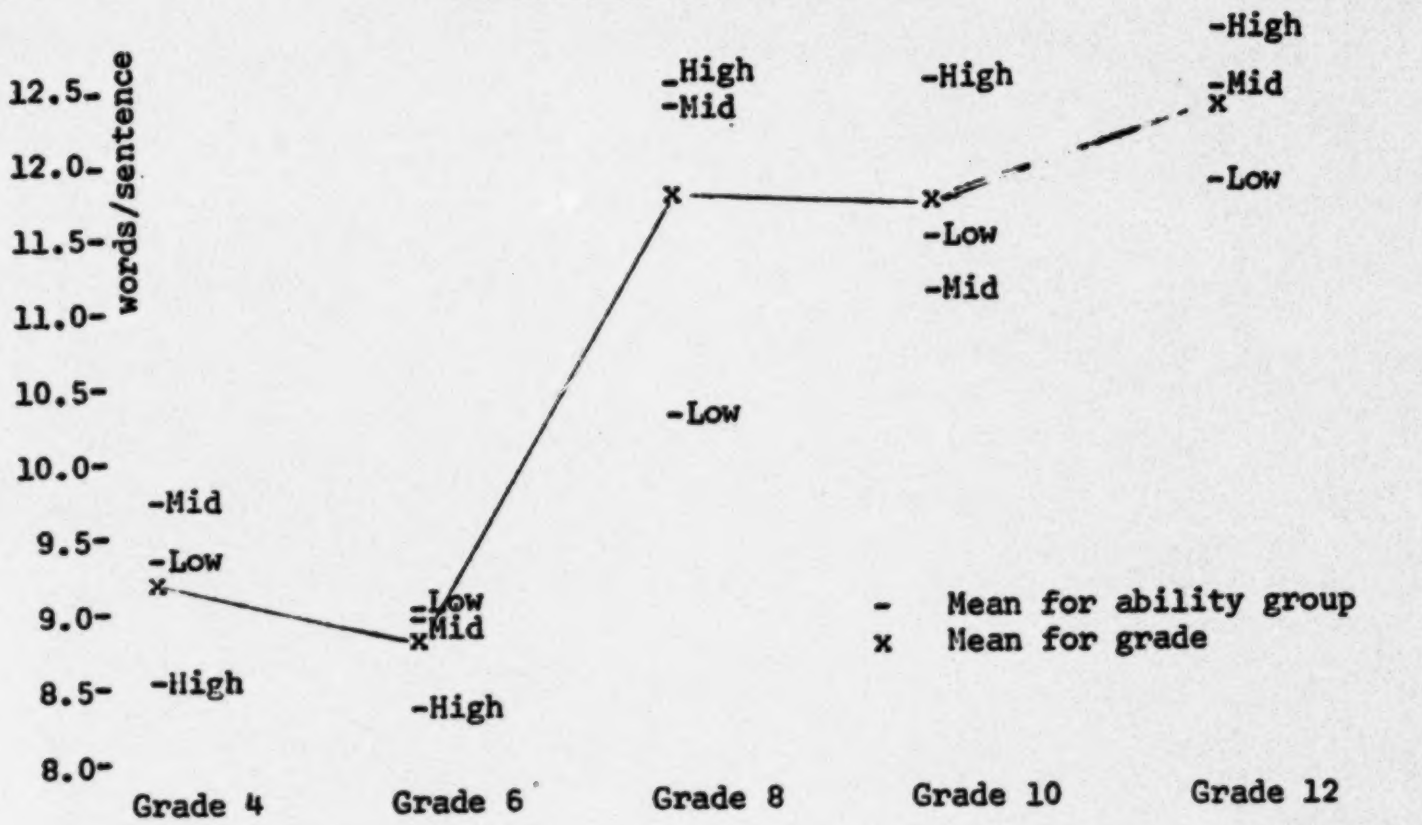

Table 1: Sentence Length

	4	6	8	10	12
Low Group	9.37	8.99	10.37	11.42	11.66
Middle Group	9.71	8.96	12.40	11.15	12.18
High Group	8.59	8.42	12.45	12.44	12.66
All Groups	9.21	8.78	11.73	11.68	12.17
Standard Deviation	3.21	2.08	2.43	2.44	2.96

Correlation with mental ability or achievement score

-.137	-.160	-.406	.137	.145

Analysis of variance

Source	SS	df	MS	F
Grade	499.84	4	124.96	17.64**
Ability	16.15	2	8.07	1.15
GXA	69.58	8	8.69	1.22
Error	1643.06	235	6.99	
Total		249		

** $p < .01$

Newman Keuls: 6 4 10 8 12

twelfth graders did. In other words, the coordination of main clauses is a tendency that declines sharply from grade 4 to grade 8, and declines still further to grade 12. Skilled adults coordinate main clauses only slightly more often than average twelfth graders, and of course they use a wider variety of means of coordination.

The O'Donnell study found similarly that in moderately controlled writing such coordination of main clauses decreased from grades 3 to 5 to 7.

This tendency observed in students' freer writing is also clearly apparent in the controlled content writings for this study, as demonstrated in Figure 2 and Table 2. That graph shows the average number of main clauses per sentence written by students in each grade. It also shows the number written by each ability group within each grade.

The graph shows that at every grade level there is a decline, at first a sharp one, then a more gradual one. Furthermore, within each grade there is a clear tendency for the more able students to coordinate main clauses less often than their less able classmates. This developmental tendency is demonstrated in greater detail in this study than it has been before.

The analysis of variance indicates significance for grade, for ability or achievement, and for interaction of grade and ability.

The facts concerning this tendency help to explain why, as noted in the previous section, the sentences written in this study by fourth graders are longer than those written by sixth graders. The fourth graders make them long by excessive coordination of main clauses.

The findings of this study confirm and make more clear the findings from studies of free writing.

Figure 2: Main Clause Coordination Index

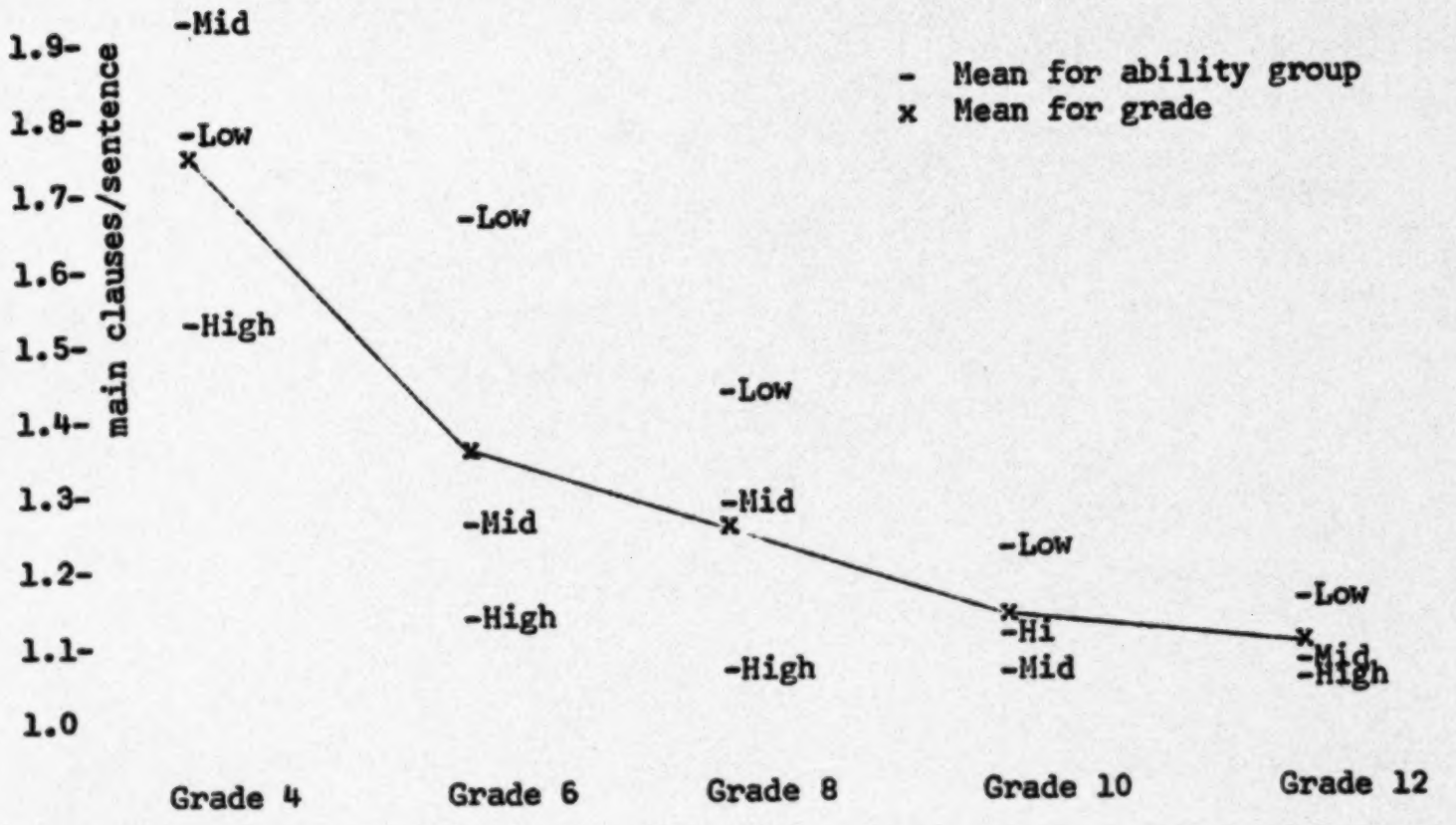

Table 2: Main Clause Coordination Index

	4	6	8	10	12
Low Group	1.782	1.647	1.410	1.215	1.148
Middle Group	1.936	1.240	1.243	1.070	1.060
High Group	1.512	1.132	1.083	1.105	1.035
All Groups	1.739	1.342	1.245	1.131	1.082
Standard Deviation	.63	.48	.26	.19	.11

Correlation with mental ability or achievement score

	4	6	8	10	12
	-.262	-.448	-.501	-.266	-.553

Analysis of variance

Source	SS	df	MS	F
Grade	13.85	4	3.46	25.77**
Ability	3.03	2	1.51	11.37**
GXA	2.21	8	.27	2.05*
Error	31.19	235	.132	
Total		249		

** $p < .01$
* $p < .05$

Newman Keuls 12 10 8 6 4

T-unit length

Since 1963, studies of children's own free speech and writing have shown that sentence length is outmoded as a quantitative indicator of syntactic maturity, at least for the early grades. They have shown that another objective measure is far better for measuring maturity both in speech and writing.

To use this newer measure the student's punctuation is disregarded. His discourse is cut up into units consisting of just one main clause plus whatever subordinate clauses are attached to or embedded within that main clause. The number of words in a passage divided by the number of such units in the passage gives the mean length of such units in number of words. This is a better index of the writer's or speaker's maturity than is either the length of his sentences or of his "phonological" units.

Since it would not violate the rules of grammar to punctuate each of these units as a sentence, and since these units would be the shortest sentences that the passage could be cut into, without leaving fragments between, these units have been called "minimal terminable units", or, for short, "T-units".

Hunt found that T-unit length increased steadily from grades 4 to 8 to 12 and increased still further in the writings of skilled adults. He found also that T-unit length was significantly greater for students of superior IQ than for students of average IQ both in grade 4, where most children are just beginning to write comfortably, and in grade 12, at the end of their public schooling.

O'Donnell and others confirmed those findings for writing, at least at grades 3, 5, and 7. They also found that T-unit length increased in the speech

of children at every interval from K to G 1, to 2, to 3, to 5, to 7. No studies have been published to indicate whether, in speech, T-unit length increases past grade 7, though, as has just been mentioned, there is evidence that it does increase, in writing, throughout the school years and into adulthood.

As in the free writing of students, the T-unit length of the writing in this controlled content study increases unmistakably with age and with ability within grade. Figure 3 and Table 3 show an increase at every grade interval. And within each grade there is an increase at every ability level except the very first where middle fourth graders have virtually the same mean score as the low fourth graders. Even so, the correlation with achievement scores is positive and significant at the .05 level even for fourth graders.

The analysis of variance indicates significance for grade, for ability or achievement, and for interaction of grade and ability.

For each individual, the T-unit length score multiplied by the main clause coordination index gives the sentence length score. It is the consequence of that arithmetical fact that explains why the sentence length graph looks as it does.

Subordinate clause index

What is here called the subordinate clause index is simply the ratio of all clauses (both subordinate and main) divided by main clauses. An equally useful ratio -- and perhaps a more immediately intelligible one -- is the ratio

Figure 3: T-unit Length

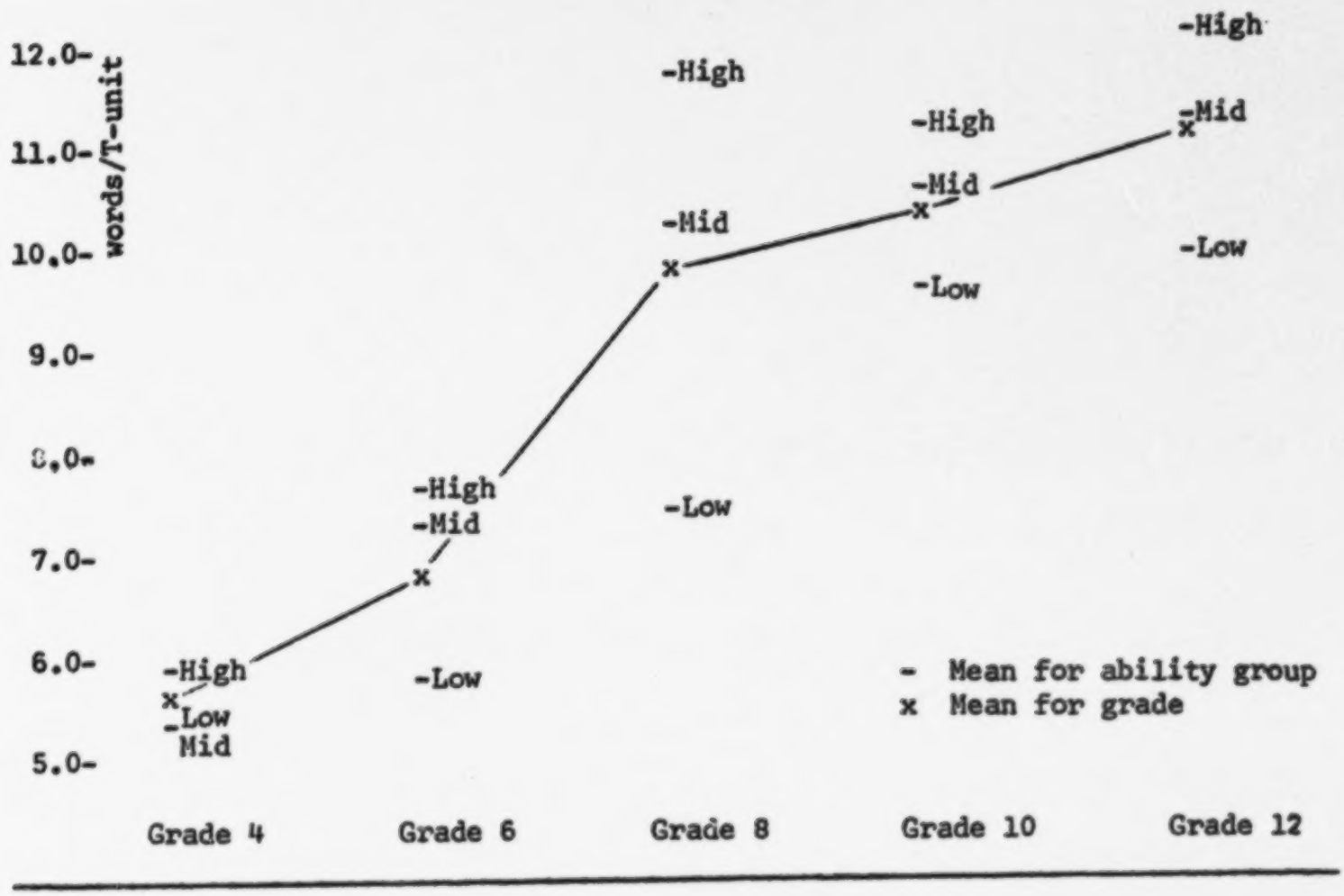

Table 3: T-unit Length

Grade:	4	6	8	10	12
Low Group	5.23	5.73	7.55	9.61	10.17
Middle Group	5.21	7.34	10.34	10.46	11.45
High Group	5.81	7.47	11.66	11.66	12.30
All Groups	5.42	6.84	9.84	10.44	11.30
Standard Deviation	1.13	1.54	3.06	2.11	2.64
Correlation with mental ability or achievement scores	.294	.443	.578	.305	.387

Analysis of variance

Source	SS	df	MS	F
Grade	1268.45	4	317.11	77.06**
Ability	179.75	2	89.87	22.03**
GXA	63.54	8	7.94	1.93*
Error	954.60	235	4.06	
Total		249		

** $p < .01$
* $p < .10$

Newman Keuls: 4 6 8 10 12

of subordinate clauses divided by main clauses. The latter ratio is always exactly one less than the former.[1]

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[1]For example, if a passage contained 10 main clauses and 1 subordinate clause (thus totalling 11 clauses), the ratio of all clauses to main clauses would be 11 divided by 10, or 1.1. The ratio of subordinate clauses to main clauses would be 1 divided by 10 or .1; obviously the one ratio is always 1 more than the other, since the other has the number of main clauses in both the numerator and denominator.

Until 1963, La Brant's "subordination ratio" was the measure generally used. It is the number of subordinate clauses divided by all clauses. One ratio is convertible arithmetically to the other, but in T-unit length studies the present ratio is more convenient.

It has long been generally accepted that as students mature they write more subordinate clauses per main clause. And in response to the instrument used in this experiment they do too -- but with a difference, in fact two differences that will be described after a brief review of findings on children's less controlled writings.

In his study of writings whose subject matter was minimally controlled, Hunt found that the number of subordinate clauses did increase significantly in the four year intervals from grades 4 to 8 and from 8 to 12, and that skilled adults wrote still more than even twelfth graders. A breakdown of the total number of subordinate clauses into the three usual sub-categories of adjective, noun, and movable adverb clauses indicated that the increase in the total number of subordinate clauses was due primarily to a steady and substantial increase in adjective clauses alone, rather than an increase in all three sub-categories separately and equally. He gained the impression that the number of noun clauses and of movable adverb clauses tends to increase with maturity, perhaps, but also to vary widely with the kind of subject matter, or topic. That is,

if a certain kind of topic elicits movable adverb clauses, then it will elicit more of them -- up to some ceiling, perhaps -- from older writers, but will also elicit more adjective clauses. And if some topic elicits noun clauses, then it will elicit more from older writers but will also elicit from older writers more adjective clauses too, but not necessarily more movable adverb clauses. However, some topics will elicit very few adverb clauses, and some will elicit few noun clauses.

In the O'Donnell study of writings in grades 3, 5, and 7, where the subject matter was indeed moderately controlled, the number of movable adverb clauses did increase, and so did the number of adjective clauses, but the number of noun clauses scarcely from grade to grade.

In the maximally controlled subject matter problem presented in this experiment, the number of subordinate clauses did indeed increase: it increased almost explosively for four years, from grades 4 to 6 to 8. But then it leveled off from grades 8 to 10 to 12, as is shown in Figure 4 and Table 4.

The analysis of variance indicates significance for grade, for ability or achievement, and for interaction of grade and ability.

The sudden rise and early leveling off is not typical of the original free writing of schoolchildren.[1] Instead it is a phenomenon elicited by this particular instrument.

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[1]In their own free writing, students produce more than this number in the fourth grade, they produce about the same number as they do here in the middle grades, but continue to produce still more until about the twelfth grade where they produce almost as many as skilled adults do.

For average fourth graders Hunt reports .25, and for superior fourth graders .33. For fifth graders O'Donnell reports .25.

For eighth graders Hunt reports .42. For seventh graders O'Donnell reports .30.

For average twelfth graders Hunt reports .68 and for superior twelfth graders .54. For skilled adults he reports .74.

Figure 4: Subordinate Clause Index

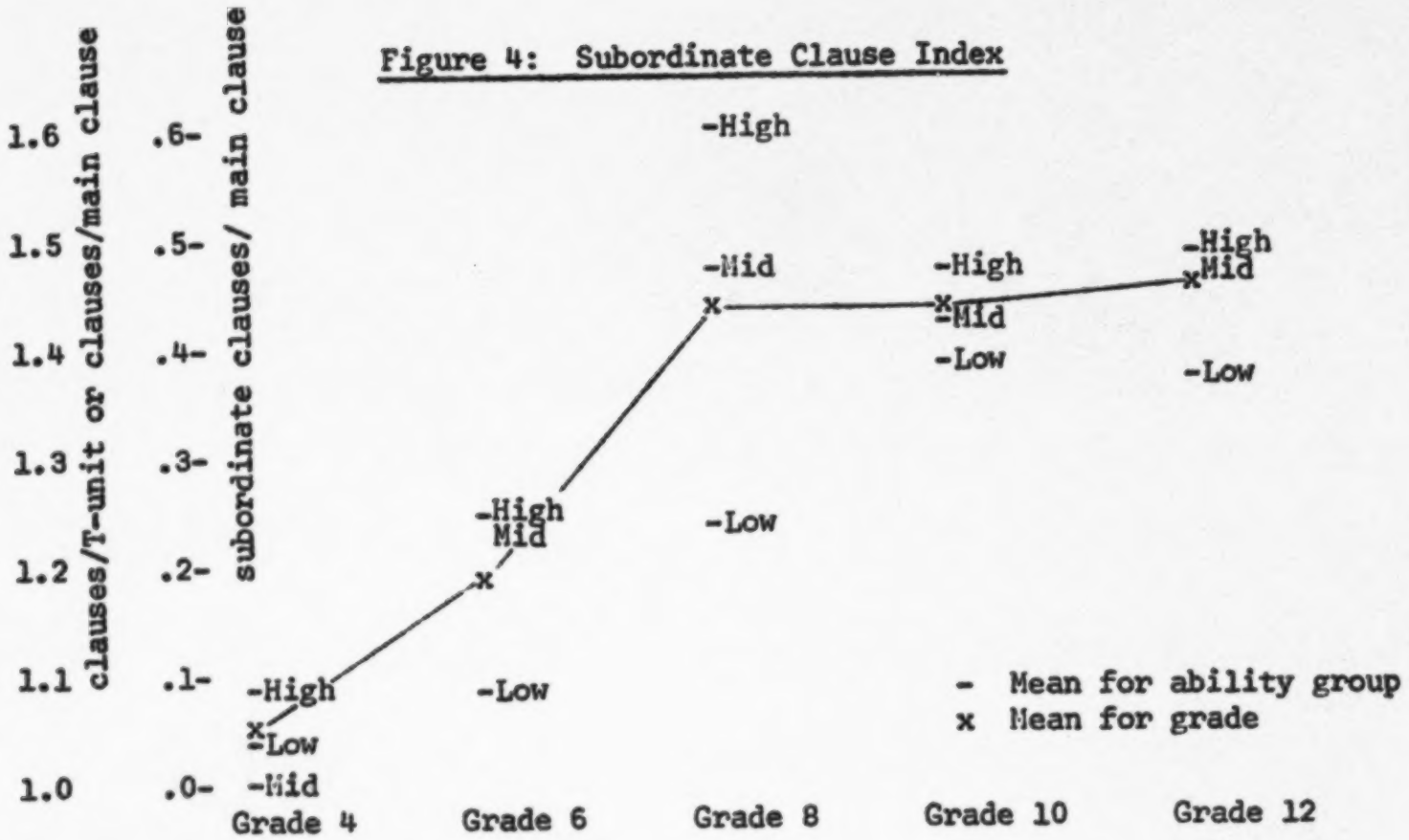

Table 4: Subordinate Clause Index

Grade	4	6	8	10	12
Low Group	1.039	1.074	1.230	1.387	1.362
Middle Group	1.003	1.237	1.461	1.412	1.484
High Group	1.085	1.237	1.601	1.458	1.481
All Groups	1.043	1.182	1.430	1.419	1.441
Standard Deviation	.108	..195	.293	.19	.269

Correlation with mental ability or achievement scores:
.259 .314 .559 .123 .243

Analysis of variance

Source	SS	df	MS	F
Grade	6.56	4	1.64	37.08**
Ability	1.03	2	.51	11.78**
GXA	.71	8	.08	2.01*
Error	10.27	235	.043	
Total		249		

** p .01
* p .05

Newman Keuls: 4 6 10 8 12

The second respect in which this controlled content problem elicited subordinate clause responses that are not typical of students' own original writing is that this instrument elicited no noun clauses and very few adverb clauses. Of all subordinate clauses elicited, about 85% were adjective clauses. However, if adjective clauses are the ones which best indicate maturity, then they are the ones a test instrument should elicit.

Clause length

It is no wonder that studies in syntactic development have, until recently, paid little attention to clause length. Growth in clause length appears to be so very slow that an investigator studying it in successive elementary grades, or successive high school grades, or in two groups of students in the same grade, is likely to find no difference at all.

Thirty years ago La Brant doubted that there was a significant difference in the clause length of students from grades 4 to 12 even though she found that eminent psychologists used clauses twice as long as those of schoolchildren. Her opinion about the lack of significant growth in clause length has been echoed as late as 1954 in McCarthy's classic summary of studies of syntactic development.

But over the whole span of the school years, and into the maturity which the skilled writer develops, there can be no doubt that clause length does increase. Though it moves with glacial slowness in the early grades, more sensitive instruments and more closely controlled studies can be expected to detect it, and studies covering a long period of time can hardly fail to do so.

In the free writing from 18 fourth graders with average IQ scores and from an equal number with IQ scores above 130, Hunt found no difference in mean clause length. Both groups had mean scores of 6.6 words. But for eighth graders of average IQ he got mean scores of 8.1. a word and a half more in four years. For twelfth graders of average IQ he got mean scores of 8.5 words, only a half word gain in four years. But for twelfth graders with IQ scores above 130 he got a mean clause length of 10.4 words and for the expository writings of skilled adults he got mean scores of 11.5 words, very substantial gains.

Though the O'Donnell study did not report clause length, it did report T-unit length and the number of subordinate clauses per T-unit, making it easy to figure what the mean clause length would have been for those writings.[1]

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[1]Mean T-unit length divided by the mean number of clauses per T-unit gives the mean clause length. The mean number of clauses per T-unit is the number of T-units (the same as the number of main clauses) plus the number of subordinate clauses.

In the O'Donnell study third grade writers would have had mean clause length scores of 6.5 words, fifth grade writings 7.4 words, and seventh grade writings 7.7 words. Hunt's figures for grades 4 and 8 fall into place with O'Donnell's. So there is substantial agreement between the two studies for the early grades. and for the adult writers Hunt's figures are substantially greater just as La Brant reported three decades ago.

In short, then, the increase in number of subordinate clauses seems now to be responsible for the most obvious gain in T-unit length that occurs in

writing as mature as that which is produced by the average twelfth grader. But the writing produced by superior twelfth graders and skilled adults is distinguished by a much greater increase in clause length, more than by a further increase in the number of subordinate clauses. For ultimate maturity, increased clause length is most important. That is the picture which emerges at present from studies of free writing.

If clause length is so important for late and full maturity, then it may deserve attention throughout the school years. One of the aims of the present study was to see whether clause length can be studied more precisely with an instrument which requires all writers to say the same thing, thus excluding variations introduced by the writer's choice as to what he will say.

The findings of this study concerning clause length appear in Figure 5 and Table 5. They show an extremely close relation to age and ability grouping. At every grade level there is an increase and for every one of the fifteen ability groups there is also an increase. The analysis of variance indicates significance for grade, for ability or achievement, and for interaction of grade and ability. The Newman Keuls test indicates that the difference is significant between every pair of grades. In other words, clause length as measured in response to this instrument is an extremely sensitive measure of some factor which is closely related to mental ability. The major concern of the following paragraphs will be to note in general just what it is that successively older students do to produce their longer clauses.

Figure 5: Clause Length

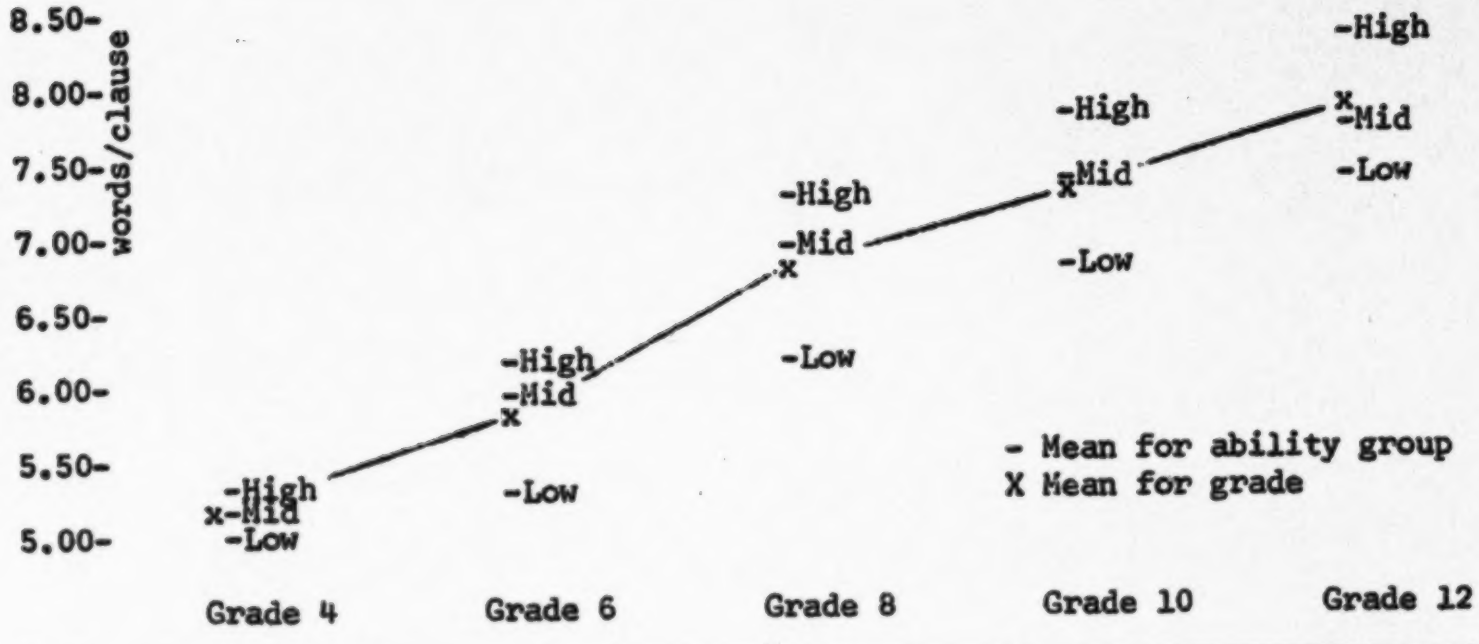


Table 5: Clause Length

Grade:	4	6	8	10	12
Low Group	5.04	5.31	6.09	6.87	7.42
Middle Group	5.19	5.92	6.98	7.39	7.72
High Group	5.33	6.05	7.30	7.81	8.39
All Groups	5.19	5.76	6.79	7.35	7.85
Standard Deviation	.88	.71	1.12	1.12	1.20
Correlation with mental ability or achievement scores:	.190	.425	.559	.368	.340

Analysis of variance

Source	SS	df	MS	F
Grade	242.29	4	60.57	64.30**
Ability	29.52	2	14.76	15.80**
GXA	5.65	8	.70	.74
Error	218.52	235	.93	
Total		249		

** $p < .01$

Newman Keuls: 4 6 8 10 12

The process by which clauses grow

Transformational grammarians have made familiar to many teachers the process by which two strings of formatives, either of which could underlie an actual sentence, are combined to produce one larger string of formatives which can, in turn, underlie one new and different sentence. And such an enlarged string can be combined again with another to produce a still longer string. It is this process which makes it possible for a speaker or writer to produce an infinite variety of sentence structures, and for a hearer or reader to understand that infinite variety.

In early writings on transformational syntax this process was described in terms of a matrix string, a constituent string, and a resultant string. The matrix string provided those constituents which are essential for what traditional grammarians have called a main clause. What the constituent string provided was usually called by traditional grammarians a modifier or a complement. In this process of transformational combination, some changes are always made in the constituent string: often, but not always, deletions occur.

When deletions occur, the constituent string is thus shortened by the number of words deleted. When this string is then embedded in the matrix string the resultant string contains fewer words than the matrix and constituent together contained to start with, but more than the matrix contained alone. To take an elementary example, Aluminum is a metal contains 4 words; It is abundant contains 3 words, for a total of 7. But once the subject and verb of the second string are deleted and the remaining adjective is embedded,

the resultant clause has been reduced to only 5 words: Aluminum is an abundant metal. Originally the 7 words were in 2 clauses, averaging 3 1/2 words; finally the clause is 5 words long: mean clause length has increased from 3 1/2 to 5.

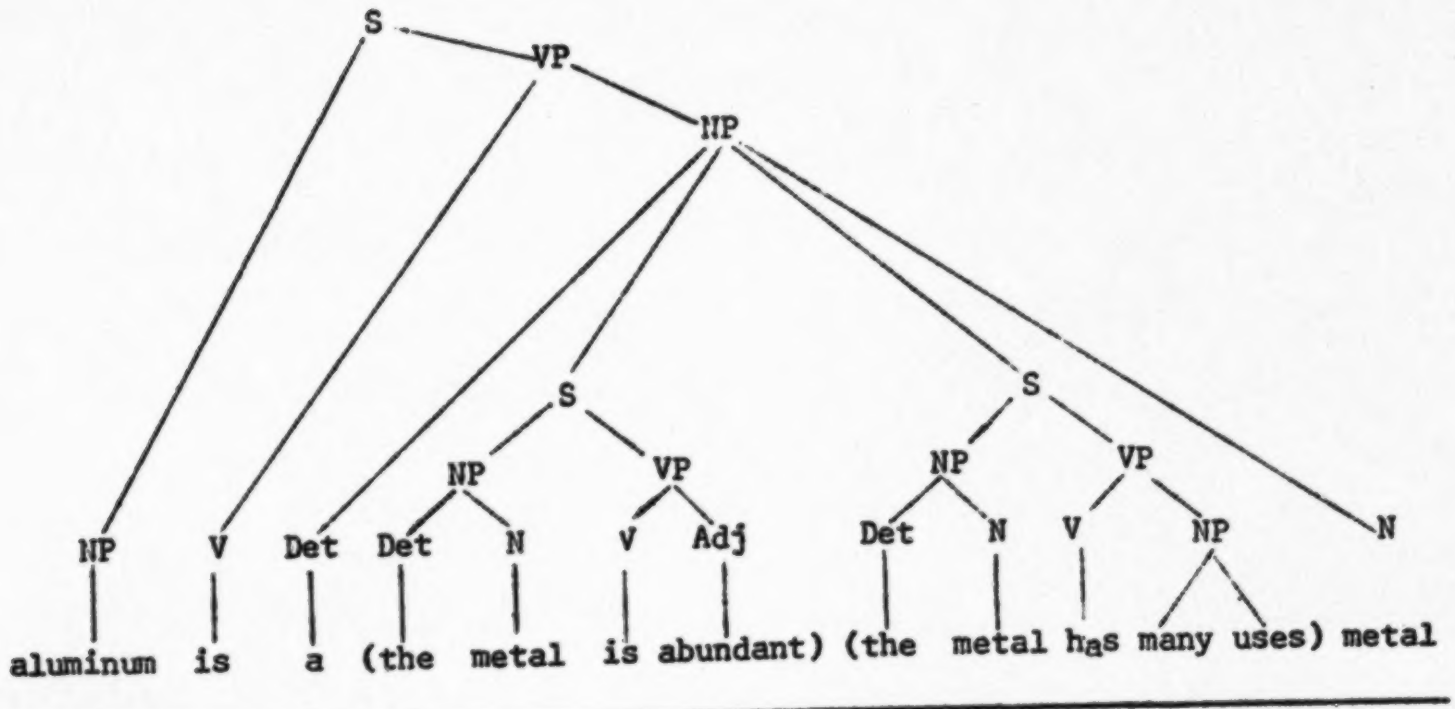
Not always are words deleted, of course. For instance, when a constituent string is made into a relative clause, the one relative pronoun often replaces one noun or pronoun. Thus, Aluminum is a metal which is abundant contains 7 words just as the two original clauses did. But even while this combining tendency is not picked up in a measure of clause length, it is picked up by a measure of T-unit length. The two original main clauses made 2 T-units, averaging 3 1/2 words. The resultant is one T-unit, 7 words long. Transformations which reduce a main clause to a subordinate clause involve the replacement or even the addition of words (when, because, that, etc.) rather than deletion.

More recent versions of transformational grammar do not use the terms matrix string, constituent string, kernel sentence. Nor do they represent complicated sentences as being built by a process that combines S constituents only two at a time through several successive stages. Instead Chomsky's Aspects of the Theory of Syntax and Katz's study of semantics, The Philosophy of Language, show the relation of 3 or more S constituents at once. Thus the simplified base phrase marker which appears below shows the 3 S constituents which together underlie and provide the semantic interpretation for a considerable variety of surface structures and actual sentences, among

them these four.

Aluminum is an abundant metal with many uses.
Aluminum is an abundant metal having many uses.
Aluminum is an abundant metal which has many uses.
Aluminum is a metal which is abundant and has many uses.

The difference between one of those four sentences and another is explained by the choice of different generalized transformations that convert the following deep structure into a surface structure.



In this later model the uppermost S represents what used to be called the matrix constituent or the main clause.[1] The other S's represent co-

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[1]In at least one version, the uppermost S plus adverbial can be rewritten as S coordinator S plus adverbial, thus generating coordinate main clauses both modified by the same adverbial: Last night I stayed home but Jim didn't. In such a version the uppermost S does not represent a single main clause, instead it represents two T-units: a compound sentence.

An alternate way to generate such a sentence would be to suppose that it came from the conjoining of two T-units Last night I stayed home, Last night Jim didn't stay home. In this alternate version the uppermost S would indeed be one main clause and one T-unit.

---

ordinated and embedded structures. Any sentence in a writer's output could thus be represented as a tree diagram whose constituent S's were the investigator's input sentences. A T-unit produced by an older writer, represented in terms of this deep structure model, would tend to contain more S constituents than a T-unit produced by a younger writer. In fact, the number of input main clauses transformed by successively older grades into an S constituent below some topmost main clause S is .2, .6, 1.5, 1.8, 2.2. If all input sentences were the same length (as they are not) and if all transformations deleted exactly the same number of words (as they do not) then the figures just given would correlate perfectly with T-unit length.

But entirely apart from the fact that older students incorporate a larger number of input sentences into a single T-unit (that is, under a single main clause), they also exhibit another developmental tendency. Older students tend to use more frequently a different set of the sentence-combining transformations. They use more that reduce a clause to less than a clause by deleting perhaps the subject or deleting the subject and part of

the predicate under certain circumstances. That remnant is embedded into another clause, either main or subordinate, thus increasing its length. It is to these transformations that we now turn.

The limited maturity shown by coordinated predicates

One way to reduce a clause to a structure less than a clause is to delete the subject, leaving the full predicate. This can be coordinated with another sentence that has the same subject.

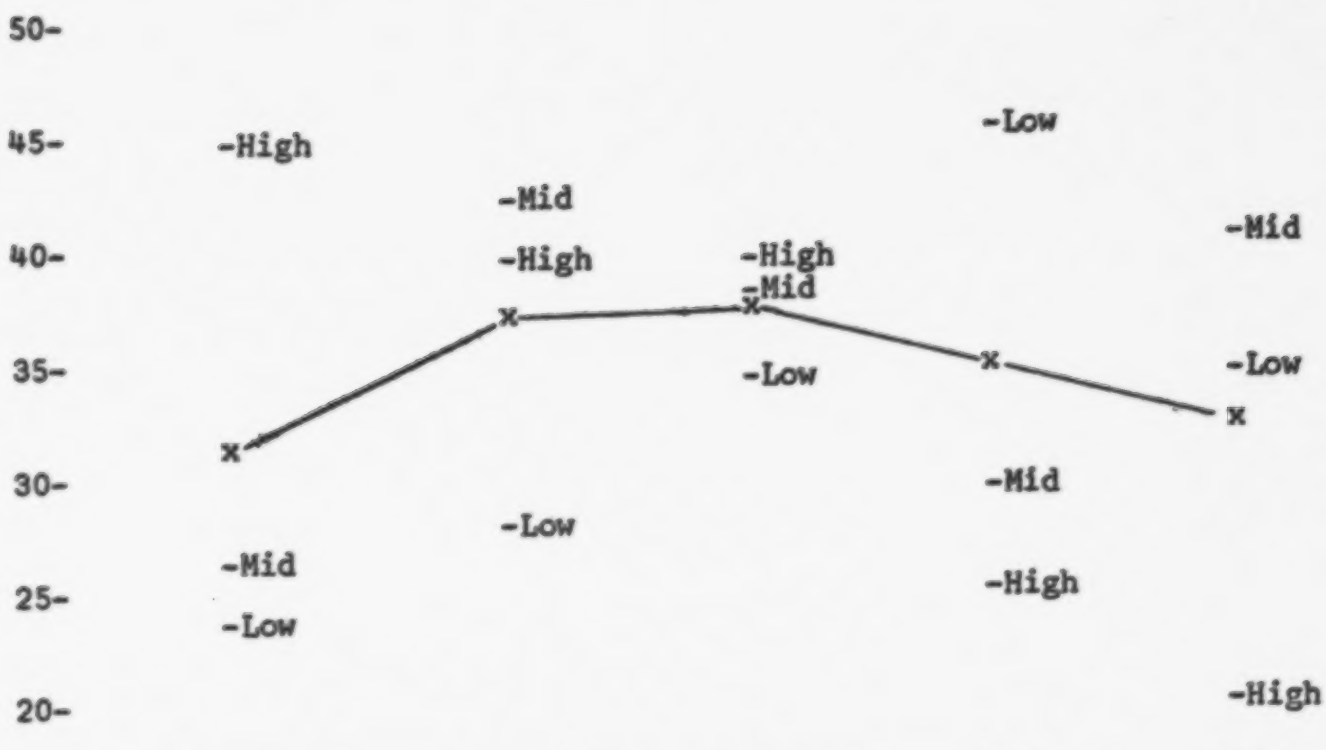
It is abundant. It has many uses.
It is abundant and has many uses.

As is shown in Figure 5a and Table 5a, coordinated predicates increase about 20% from grade 4 to grades 6 and 8 and then decrease again to almost fourth grade frequency. In other words, from grades 4 to 8 students learn to use this transformation (along with others) more frequently, but then later they learn instead to replace these transformations with still more mature transformations.

In an earlier study of free writing, Hunt remarked upon what seemed to be this same tendency for eighth graders to use more coordination within clauses than either younger or older students did.

As will next be demonstrated, those transformations that are used more frequently by the older students are the ones that delete more than the subject: they delete or replace part of the verb as well, either the tense and number marker, making the verb what traditional grammarians call non-finite, or they delete the verb entirely when that can be done. In this way

Figure 5a: Coordinated Predicates



Note: In order to make the total for each grade comparable to the total for each ability group within that grade, the actual total for each grade (see Table 5a below) has been divided by 3 and then plotted above.

Table 5a: Coordinated Predicates

Grade:	4	6	8	10	12
Low Group	23	28	34	46	35
Middle Group	26	43	38	29	42
High Group	44	40	40	26	21
Total	93	111	112	101	98

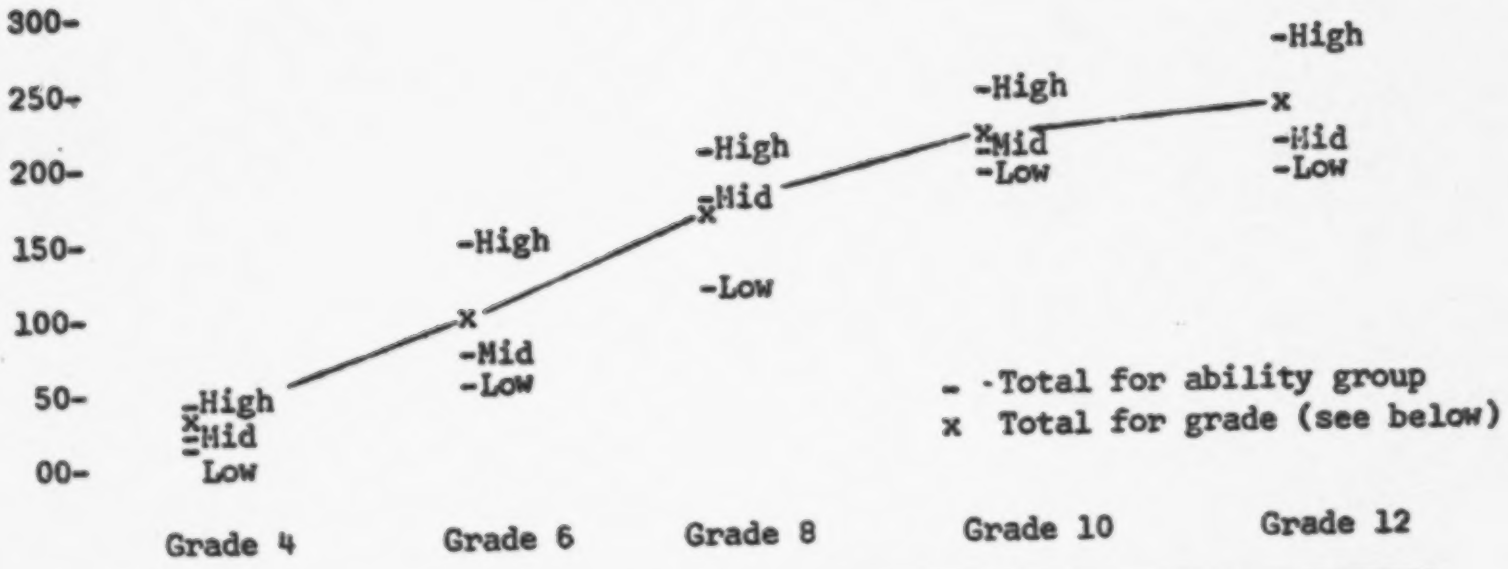
the clause is reduced to less than a full predicate. In the next section it will be shown that this distinction seems very important for understanding and measuring syntactic maturity.

Reduction to less than a predicate

In contrast with the transformation just mentioned which retains the full predicate, coordinating it with another sentence, there are many transformations which embed one S constituent in another after deleting more than just the subject. In addition to the subject, some also delete the finite verb marker, replacing it with a to or -ing: They grind the bauxite becomes . . . grinding the bauxite . . . ; Workmen separate the aluminum . . . becomes . . . separating the aluminum . . . This is one way in which structures are reduced to less than a full predicate. Other transformations replace certain verbs with, perhaps, a preposition: It has many uses becomes . . . with many uses . . . , again something less than a predicate. Or the verb, especially a copula, is deleted: Bauxite is an ore becomes bauxite, an ore, an appositive, and something less than a predicate.

The following chapter will report on the use of these transformations in some detail. At this point it is sufficient merely to record the total for each grade and for each ability group within each grade in Figure 6 and Table 6. After all that has been said so far, it should be no surprise that the graph mirrors the steady rise shown in Figure 5 representing clause length.

Figure 6: Less Than A Predicate



Note: In order to make the total for each grade comparable to the total for each ability group within that grade, the actual total for each grade (See Table 6 below) has been divided by 3 and then plotted above.

Table 6: Less Than A Predicate

Grade	4	6	8	10	12
Low Group	18	59	112	182	189
Middle Group	22	88	169	200	211
High Group	43	152	205	242	276
All Groups	83	299	486	624	676

Some of the original questions are by this time answered affirmatively.

1. When all students are saying the same thing, older students do indeed tend to say it in longer clauses.

2. They do indeed use more sentence-combining transformations to produce their longer clauses. They reduce more clauses to less than a predicate.

3. The differences are indeed related to mental age -- or general academic ability -- as well as to chronological age. Within every grade the correlation between clause length and ability score is positive, and the correlation within all grades but the youngest is large enough to be significant at the .05 level. The Newman Keuls test indicates that the difference between the high ability group and the low is significant at every grade level.

A summarizing diagram

The syntactic changes discussed so far can be pulled together in a single diagram, Figure 7 and Table 7. Thirty-two sentences, all single main clauses, were the input to all the schoolchildren. A few of those sentences never appeared in the output which was analyzed. Either the writer forgot them, or he intentionally omitted them, or they were excluded by the analysts because they appeared in a sentence in which there also appeared some added or inaccurate information. The number of these that never survived to be analyzed is approximately the same for each grade, and the total is represented in the diagram as Not Analyzed. Of those that remain, the number of input

Figure 7: Input and Output Structures

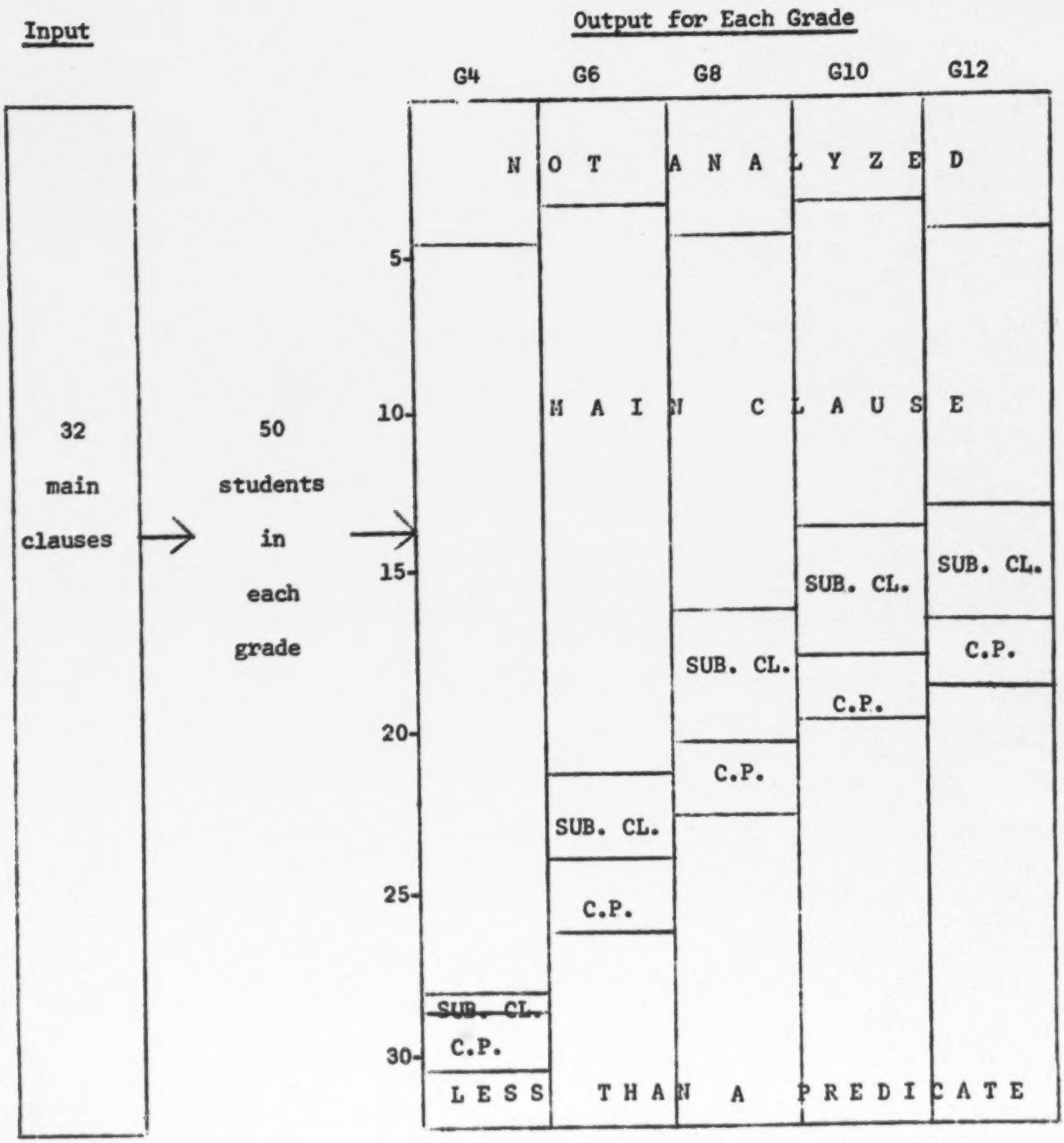


Table 7: Frequency of Various Output Structures

		Full Clauses		Less Than A Clause	
	Not Analyzed	Main Clause	Subordinate Clause	Coordinated Predicate	Less Than A Predicate
Grade 4					
Low Group	7.00	22.24	.35	1.35	1.24
Middle Group	3.37	25.56	.62	1.62	.83
High Group	3.53	22.06	1.29	2.59	2.53
Mean for Grade	(-)4.66	23.24	.58	1.86	1.66
			23.82		3.52
Grade 6					
Low Group	4.12	21.53	1.24	1.65	3.46
Middle Group	4.06	16.37	3.37	2.69	5.51
High Group	1.47	15.59	3.65	2.35	8.94
Mean for Grade	(-)3.20	17.86	2.74	2.22	5.98
			20.60		8.20
Grade 8					
Low Group	5.35	15.29	2.76	2.00	6.60
Middle Group	3.62	11.12	4.31	2.38	10.57
High Group	3.76	8.71	5.12	2.35	12.06
Mean for Grade	(-)4.26	11.72	4.06	2.24	9.72
			15.78		11.96
Grade 10					
Low Group	3.41	11.47	3.71	2.71	10.70
Middle Group	3.62	10.06	4.00	1.81	12.51
High Group	2.35	9.41	4.47	1.53	14.24
Mean for Grade	(-)3.12	10.32	4.06	2.02	12.48
			14.38		14.50
Grade 12					
Low Group	6.29	9.53	3.00	2.06	11.12
Middle Group	3.62	8.75	3.81	2.62	13.20
High Group	2.88	7.65	4.00	1.24	16.23
Mean for Grade	(-)4.28	8.64	3.60	1.96	13.52
			12.24		15.48

main clauses that were transformed into certain structures were either so nearly the same from grade to grade, or were so few in any grade, that any increase or decrease in their number seems relatively insignificant in the larger developmental picture. Those structures, forming a band rising across the middle of the diagram, are the coordinated predicates (noted as C.P. in the diagram), and the subordinate clauses (Sub. Cl.). The great developmental difference from grade to grade is in the number of main clauses that were reduced to structures less than a predicate. The likelihood that one clause will have another structure less than a clause embedded within it is ten times as great in the twelfth grade as in the fourth grade.

Precisely what these structures were that were less than a predicate is the subject for the next chapter.

The Performance of Skilled Adults

A very important question to ask about the results of this study is whether these developmental tendencies are characteristic of schoolchildren alone, and counter to the practices of "good writers." Do, in fact, "good writers" reverse the tendencies described here?

To answer that question the same instrument which was given to the schoolchildren was sent also to a considerable number of persons who in recent months had published non-fiction articles in Harpers and Atlantic. Accompanying the instrument was a letter soliciting their aid, telling them the purpose of the experiment, and promising them a copy of the final report if they would participate. They were told nothing about the kinds of measurements

to be used. Ninety-five people had to be asked before 25 returned the passage re-written. Of those who thus complied with the request, one or two protested that it could not be re-written adequately, but one said it was an inviting problem and he sent along a couple of versions written by friends of his.

There is no way to know whether the skilled adults spent more or less time than the schoolchildren did rewriting the passage. No one could compare their writings with the writings of schoolchildren and fail to sense the greater resources that most, if not all, the skilled adults demonstrated. They felt more freedom with the assignment, as if they were willing to take this information and re-write it but not until they had absorbed it and made it their own.

When one excludes every sentence containing any bit of information that failed to appear in the original, he excludes a greater proportion of what they wrote than of what the schoolchildren wrote. For one thing the sentences so excluded were longer, they contained a bigger piece of the whole passage. But whether one excludes certain passages or makes his syntactic analysis on everything they wrote makes very little difference in the results. In the next paragraphs, the figures given in the text will be for the original passage minus the sentences that would have been excluded by following the rules used for the schoolchildren.

The final conclusion to be drawn about the writing of skilled adults is that it does indeed extend the trends already described as characteristic of

syntactic maturity in schoolchildren. There is no evidence whatsoever that the schoolchildren are moving in a wrong direction. For every one of the five syntactic measures in the Synopsis of Clause to Sentence Length Factors, skilled adults extend the trends that correlate with maturity from grades 4 to 12.

The mean clause length of skilled adults is 9.95 words, whereas that for twelfth graders is only 7.85. Their subordinate clause index is 1.51, whereas that for twelfth graders is only 1.44. Their mean T-unit length is 14.78 words, whereas that for twelfth graders is only 11.30. Their main clause coordination index is 1.05, whereas that for twelfth graders is up to 1.08. Their mean sentence length is 15.22 words, whereas that for twelfth graders is only 12.17.[1]

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[1]If we exclude none of the sentences they wrote, the figures are only slightly changed from those given above: clause length 10.07 instead of 9.07; subordinate clause index 1.60 instead of 1.51; T-unit length 15.98 instead of 14.78; main clause coordination index 1.07 instead of 1.05; sentence length 16.83 instead of 15.22.

Some of these differences are worth noting in greater detail. Of the 25 skilled adults, 23 wrote longer clauses than the average for twelfth graders as a whole, and 22 wrote longer clauses than the mean for superior twelfth graders. (One suspects that one or two of the skilled adults with the lowest scores felt they were writing down for children, but of course this impression is not verifiable.) The superiority of skilled adults over twelfth graders is 2.10 words, four fifths as great as the superiority of twelfth graders over fourth graders. This supports the conclusion Hunt came

to after studying the free writing of skilled adults: that if the average high school graduate is ever to write like a skilled adult he has nearly as much yet to learn about how to embed more clauses as he learned in all of his public school years.

The present device as a measuring instrument

The instrument used here as a research instrument has obvious uses for the measurement of syntactic maturity in new populations. Apparently it gives results which are closely comparable to those obtained by studying a large body of free writing.

Its great advantage over free writing is the speed with which it can be administered and scored. At any grade level it is virtually self-administering, and can be completed in a class period of about 40 minutes. To score it requires only a knowledge of what is and what is not a clause. The scorer needs only to mark the number of clauses or of T-units in the student's writing. He can mark a paper in a couple of minutes. Anyone can then count the number of clauses or T-units, the number of words, and divide the latter by the former to get mean clause length or T-unit length, which would serve as the score of the writer's maturity. The scores provided by this research could be used as something approaching norms.

An experimental curriculum designed to accelerate syntactic maturity might well use this instrument as one of the devices for measuring the success of the program.

Though the statistical evidence already presented suggests that this instrument is probably reliable for measuring group achievement, there is no

evidence yet as to how reliable it is for measuring the syntactic performance of an individual in his free writing. To get such evidence it might be necessary to compare the performance of several individuals on this instrument and also on rather large samples of free writing covering a wide variety of topics.

The possibility for further refinement

There is no reason to suppose that the instrument used here could not be improved upon. It elicits a relatively small range of transformations. For instance, it elicits relatively few nominalizing transformations: those which transform a whole sentence or part of a sentence into a nominal which then serves as subject or object in another sentence. In all probability the growth of nominalizing transformations closely parallels growth in the ability to abstract.

Whether another instrument eliciting a wider variety or a different set of transformations would have a superior power of discrimination and a closer correlation to actual syntactic maturity as demonstrated in free writing remains to be seen.

The instrument used here for research had to be suitable for a very wide range of grades. For measuring purposes, perhaps an instrument for use in the earlier grades alone or the later grades alone could be made more sensitive. It will be shown in a later section that a second instrument did indeed succeed in achieving a slightly higher correlation with achievement scores in the early grades, though it was not suitable for research across the full range of grades, since its ceiling was too low.

What does this instrument measure?

Using mean clause length or T-unit length as the raw score, this instrument measures the writer's ability to reduce main clauses to structures that are less than a predicate.

To call it a test of syntactic maturity is in one sense reasonable, and in another sense pretentious. Unquestionably it measures an ability that is related to maturity, even to high adult accomplishment. And clearly it does not measure the size of a student's productive vocabulary, nor his use of the standard dialect, nor his spelling, nor his punctuation, nor his inventiveness or creativity. Clearly what it measures is, instead, syntactic. So in that sense it is a test of syntactic maturity.

But no one has evidence for asserting that this instrument measures all there is to syntactic maturity. No one knows all that goes into syntactic maturity. So in this special sense it is pretentious to call this instrument, or any other for that matter, a test of syntactic maturity.

English professors are quick to assert, quite rightly, that the good writer is clear and simple and the bad writer is often complex and turgid. It may in the future be possible for quantitative studies of syntax to give a more precise meaning to "simple" and "clear." But for the present one can only point to the performance of the skilled adults and say, "The present measure cannot be wholly mistaken."

Summary of findings

On the whole, the findings of this controlled content writing study support and confirm the findings of studies in which the content is only

moderately or minimally controlled by the investigator: studies of "free" writing. Some of the findings of this study are clearly a refinement upon the findings of the less controlled studies. At least this study provides direct evidence as to how it is that more mature students express themselves when in fact all are instructed to express the same thing.

1. As students mature they tend to reduce more of these input main clauses to structures that are less than a predicate -- that is, to words and phrases -- and to incorporate them within the main clauses they retain. The tendency increases in almost a straight line.

2. As a consequence of this tendency their average number of words per clause increases.

3. The two tendencies just described are correlated with general academic ability. That is, within the same grade (and hence the same chronological age group), students with higher mental age and ability scores excel in syntactic maturity those with average scores, and those in turn excel others with below average scores.

   However, the range of scores within groups is sufficiently large to suggest that this test is not just another intelligence test.

4. On this instrument, the number of input main clauses reduced to subordinate clauses -- almost always adjective clauses -- increases sharply from G4 to G6 and from there to G8. The number then levels off and is virtually the same for G8, G10, and G12.

When children write freely, without their content being controlled, other studies show that there is a steady increase in the number of subordinate clauses -- particularly adjective clauses -- from grades 3 to 12, and that skilled adults write still more of them. So this early leveling off at G 8 is characteristic of the response to this instrument, but is not characteristic of free writing.

5. The coordination of main clauses tends to decrease with maturity, both chronological and mental, just as it does in free writing.

6. In the number of coordinated predicates there is little developmental significance to be seen after G6. Fourth graders use the fewest, then sixth and eighth graders use about twenty per cent more, then the two older grades drop down a little until they approach the fourth grade level.

7. As a consequence of the tendency to produce more subordinate clauses and longer clauses, more mature students tend to produce longer T-units.[1]

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[1]By definition, for any body of writing, the mean clause length multiplied by the subordinate clause index equals the mean T-unit length.

$$\frac{\text{words}}{\text{clauses}} \times \frac{\text{clauses}}{\text{T-units}} = \frac{\text{words}}{\text{T-units}}$$

The fact that mid fourth graders fail to write longer T-units than low fourth graders is explained by the fact that the middle group's superiority in clause length is not arithmetically sufficient

to offset the low group's superiority in the subordinate clause index.

8. As a consequence of 7 above, more mature students tend to write somewhat longer sentences.[1] At least it is true that the three

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[1]By definition, for any body of writing, the mean T-unit length multiplied by the main clause coordination index equals the mean sentence length.

$$\frac{\text{words}}{\text{T-units}} \times \frac{\text{T-units}}{\text{sentences}} = \frac{\text{words}}{\text{sentences}}$$

Combining this footnote with the previous one,

$$\frac{\text{words}}{\text{clauses}} \times \frac{\text{clauses}}{\text{T-units}} \times \frac{\text{T-units}}{\text{sentences}} = \frac{\text{words}}{\text{sentences}}$$

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older grades write longer sentences than the two younger grades.

Sentence length is a less valid index of maturity than any of the other indexes here presented, both for free writing and for the controlled content writing in this experiment.[2]

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[2]As was explained in the last footnote, the mean sentence length of any body of writing is the arithmetical product of three tendencies which are not arithmetically related though they all appear to be related to maturity. Consequently, the characteristics of sentence length can be explained as the consequences of three other trends. The other trends explain why sentence length is no worse and no better than it is as an index of maturity.

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10. The instrument used here for research holds promise also for use as a measuring instrument, with mean clause length or T-unit length serving as the raw score on the test. The instrument is almost self-administering, it takes less than 40 minutes of classtime, it takes about 2 minutes for a somewhat skilled grammarian to mark the number

of clauses or T-units, it takes a short time more to count the number of words. It is acceptable to students in all grades beginning with the fourth, and even to some skilled adults.

How reliable it is for measuring individual achievement could only be ascertained by rather extensive research covering a large body of writing on perhaps a wide range of topics for each individual.